A: Datasheet

Algorithm: cloudwalk_hr_000

Developer: Cloudwalk − Hengrui AI Technology

Submission Date: 2021_02_10

Template size: 2048 bytes

Template time (2.5 percentile): 904 msec

Template time (median): 905 msec

Template time (97.5 percentile): 939 msec

Investigation:

Frontal mugshot ranking 14 (out of 279) −− FNIR(1600000, 0, 1) = 0.0015 vs. lowest 0.0009 from sensetime_005

Mugshot webcam ranking 18 (out of 241) −− FNIR(1600000, 0, 1) = 0.0099 vs. lowest 0.0062 from sensetime_005

Mugshot profile ranking 3 (out of 210) −− FNIR(1600000, 0, 1) = 0.0635 vs. lowest 0.0587 from xforwardai_002

Immigration visa−border ranking 4 (out of 168) −− FNIR(1600000, 0, 1) = 0.0019 vs. lowest 0.0013 from visionlabs_010

Immigration visa−kiosk ranking 1 (out of 165) −− FNIR(1600000, 0, 1) = 0.0568

Identification:

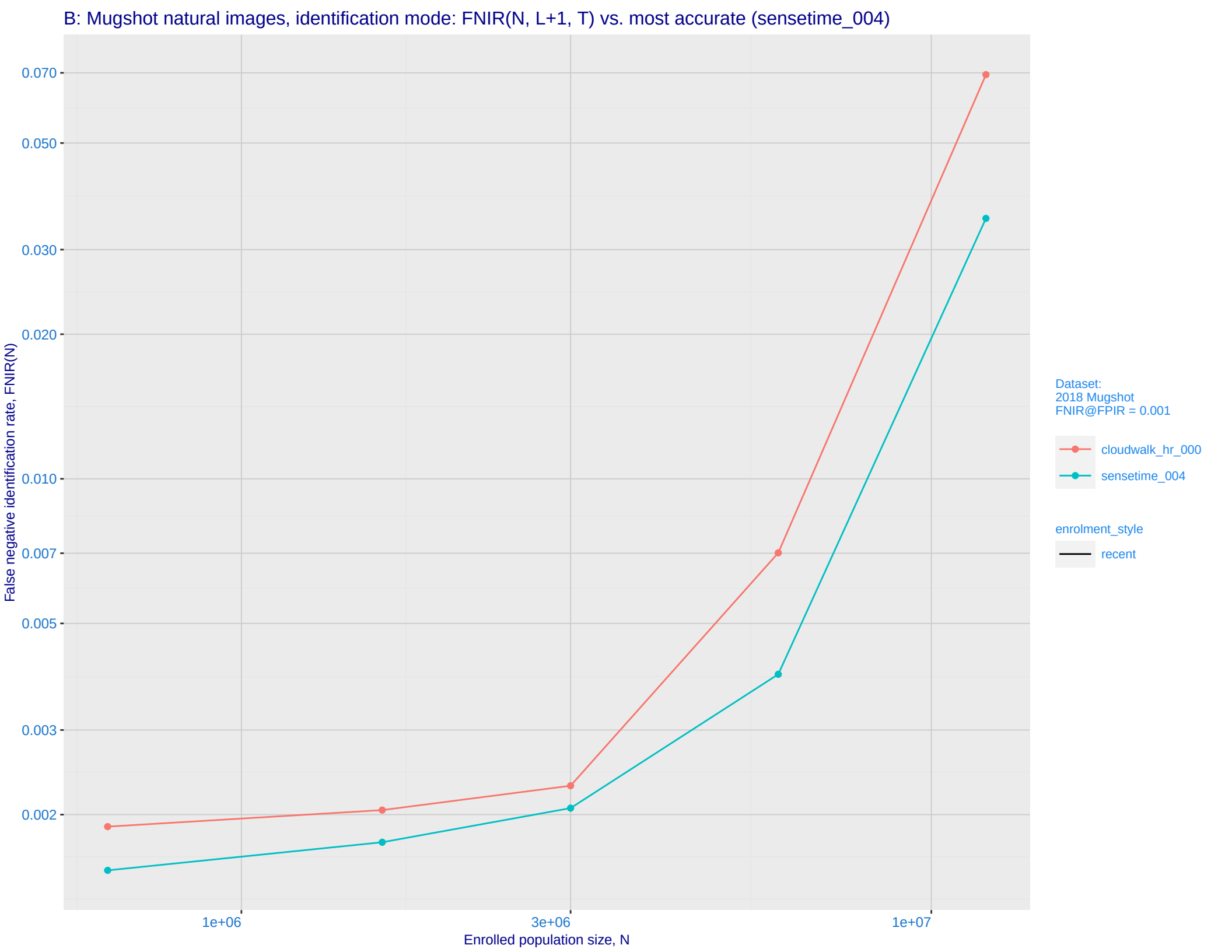
Frontal mugshot ranking 4 (out of 279) −− FNIR(1600000, T, L+1) = 0.0020, FPIR=0.001000 vs. lowest 0.0018 from sensetime_004

Mugshot webcam ranking 4 (out of 236) −− FNIR(1600000, T, L+1) = 0.0134, FPIR=0.001000 vs. lowest 0.0122 from sensetime_003

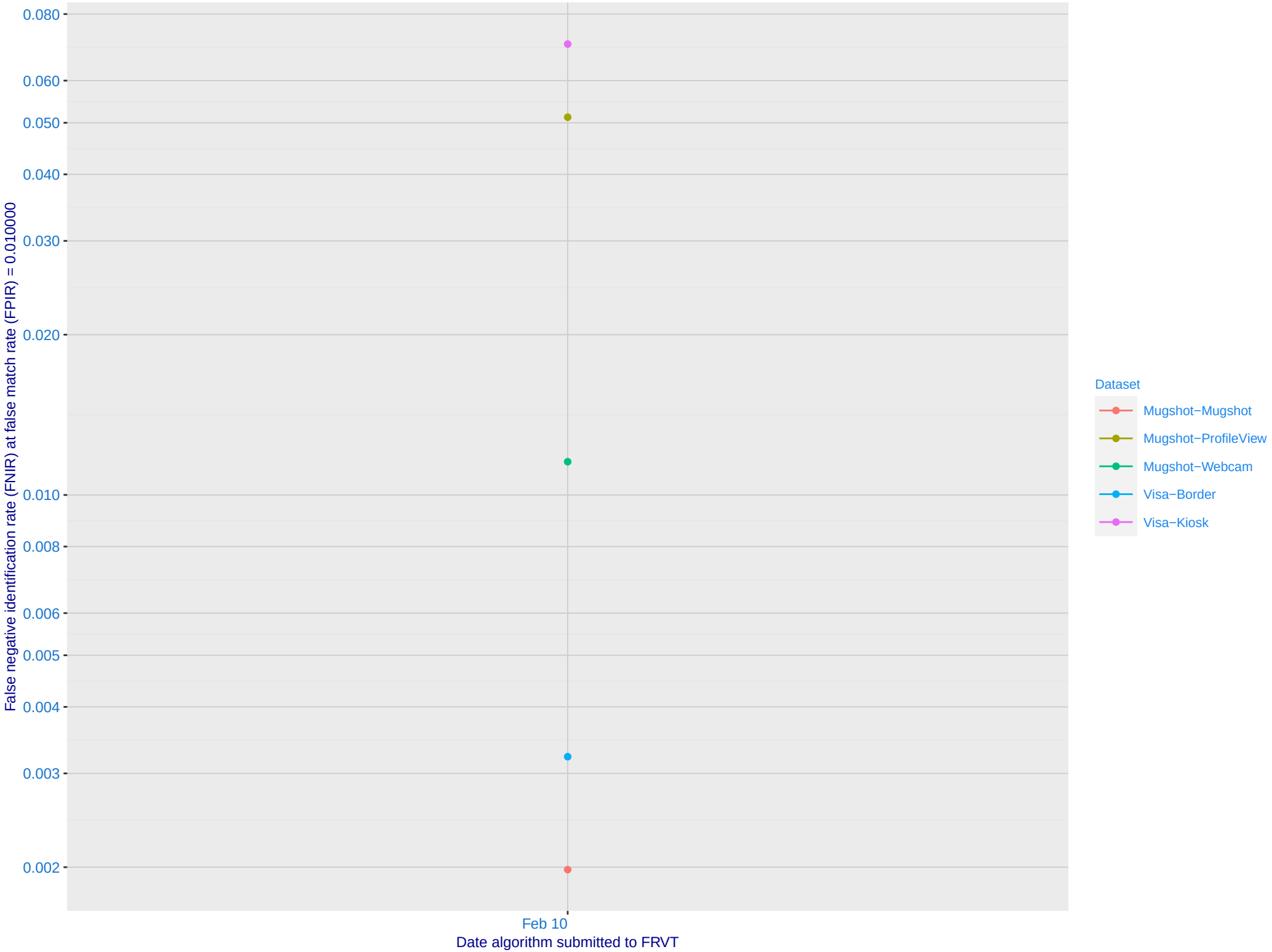
Mugshot profile ranking 1 (out of 209) −− FNIR(1600000, T, L+1) = 0.1331, FPIR=0.001000

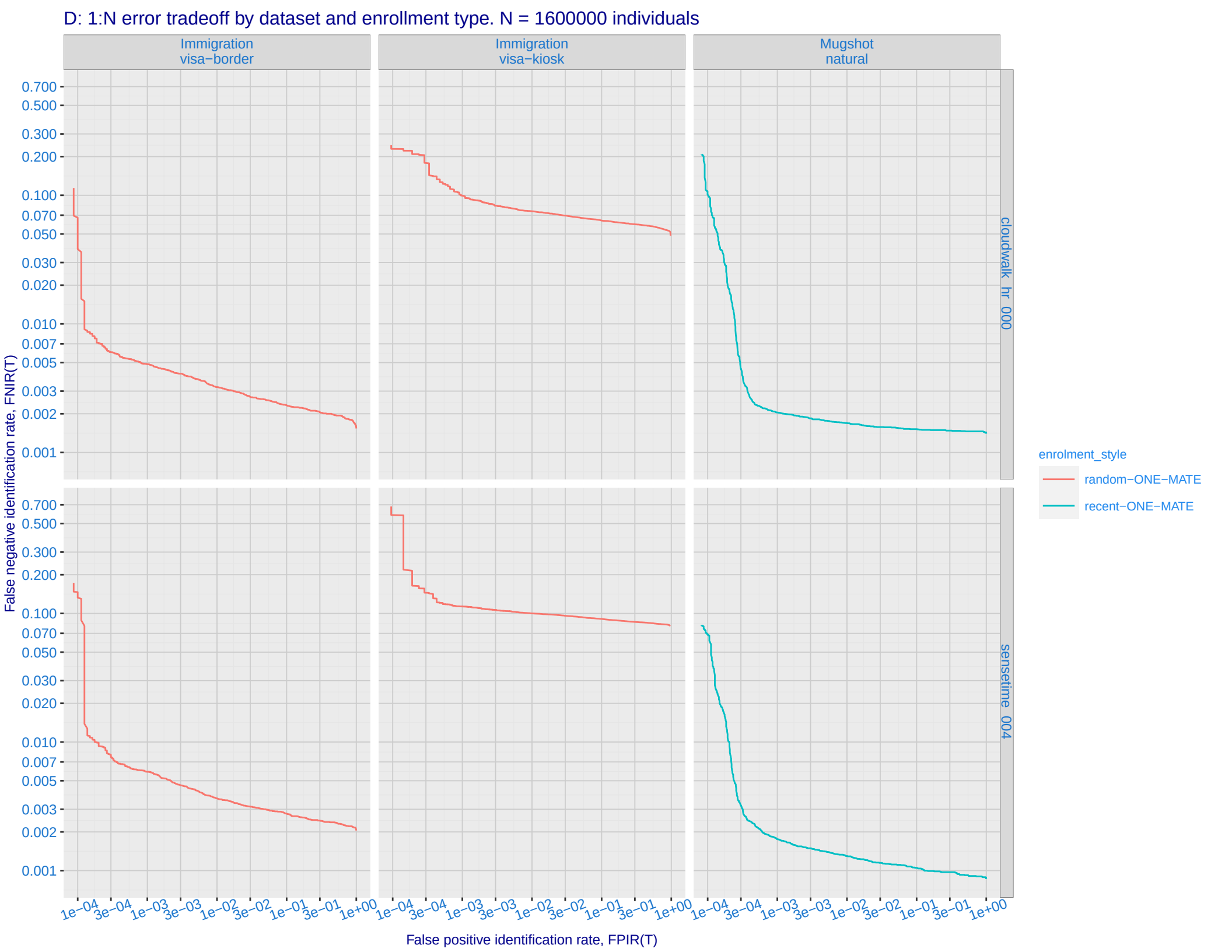
Immigration visa−border ranking 2 (out of 167) −− FNIR(1600000, T, L+1) = 0.0049, FPIR=0.001000 vs. lowest 0.0047 from idemia_008

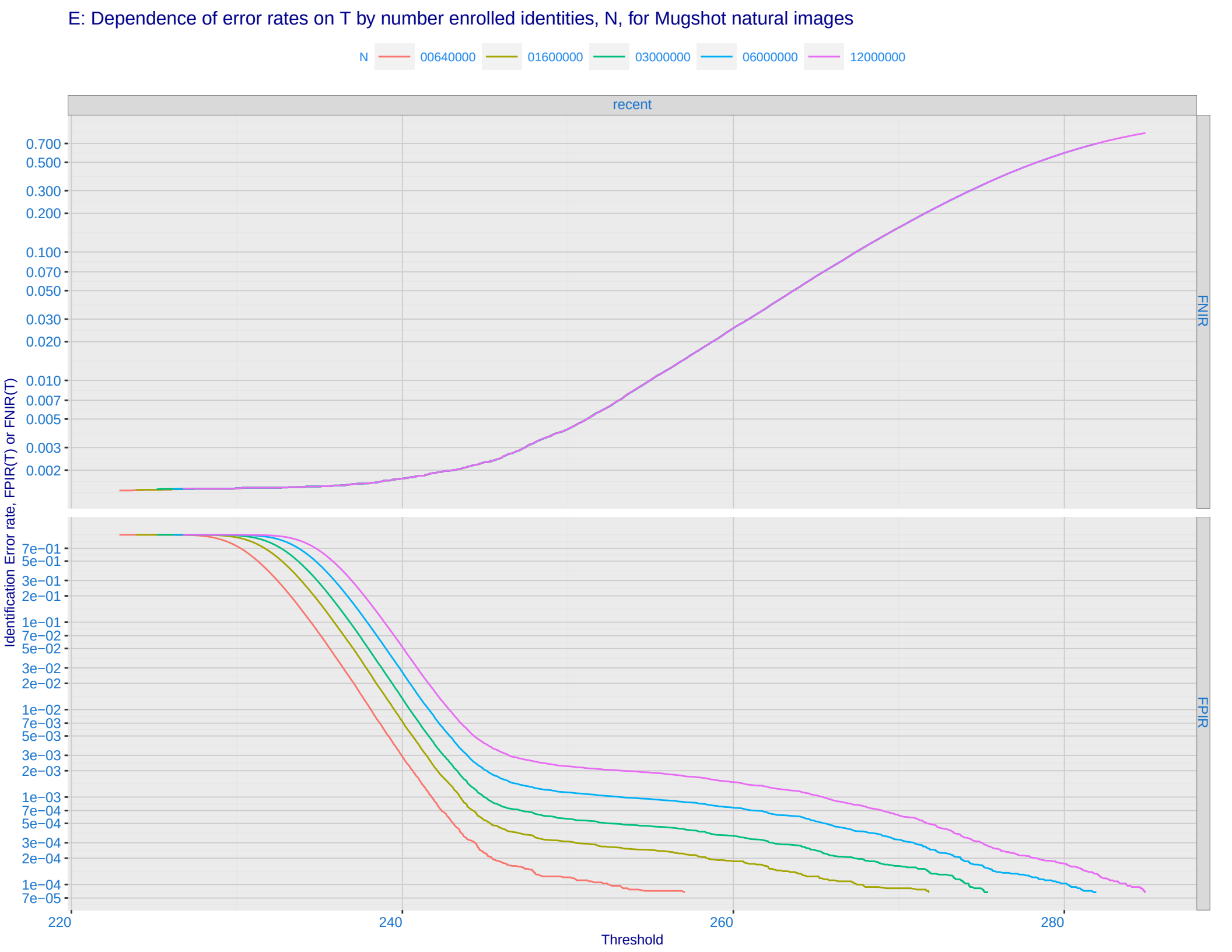
Immigration visa−kiosk ranking 1 (out of 162) −− FNIR(1600000, T, L+1) = 0.0996, FPIR=0.001000

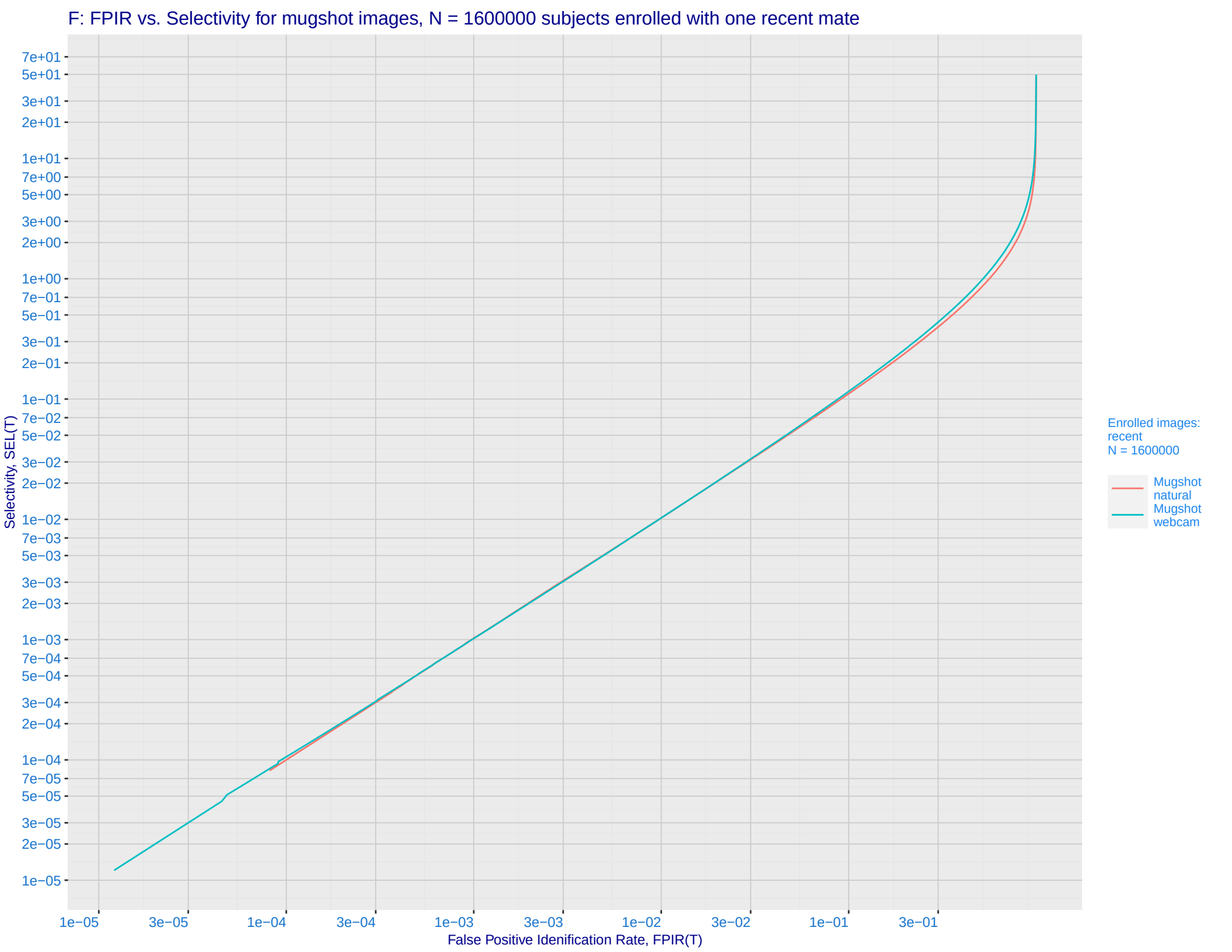

B: Mugshot natural images, identification mode: FNIR(N, L+1, T) vs. most accurate (sensetime_004)
False negative identification rate, FNIR(N)
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
1e+06
3e+06
1e+07
Enrolled population size, N
Dataset:
2018 Mugshot
FNIR@FPIR = 0.001
cloudwalk_hr_000
sensetime_004
enrolment_style
recent

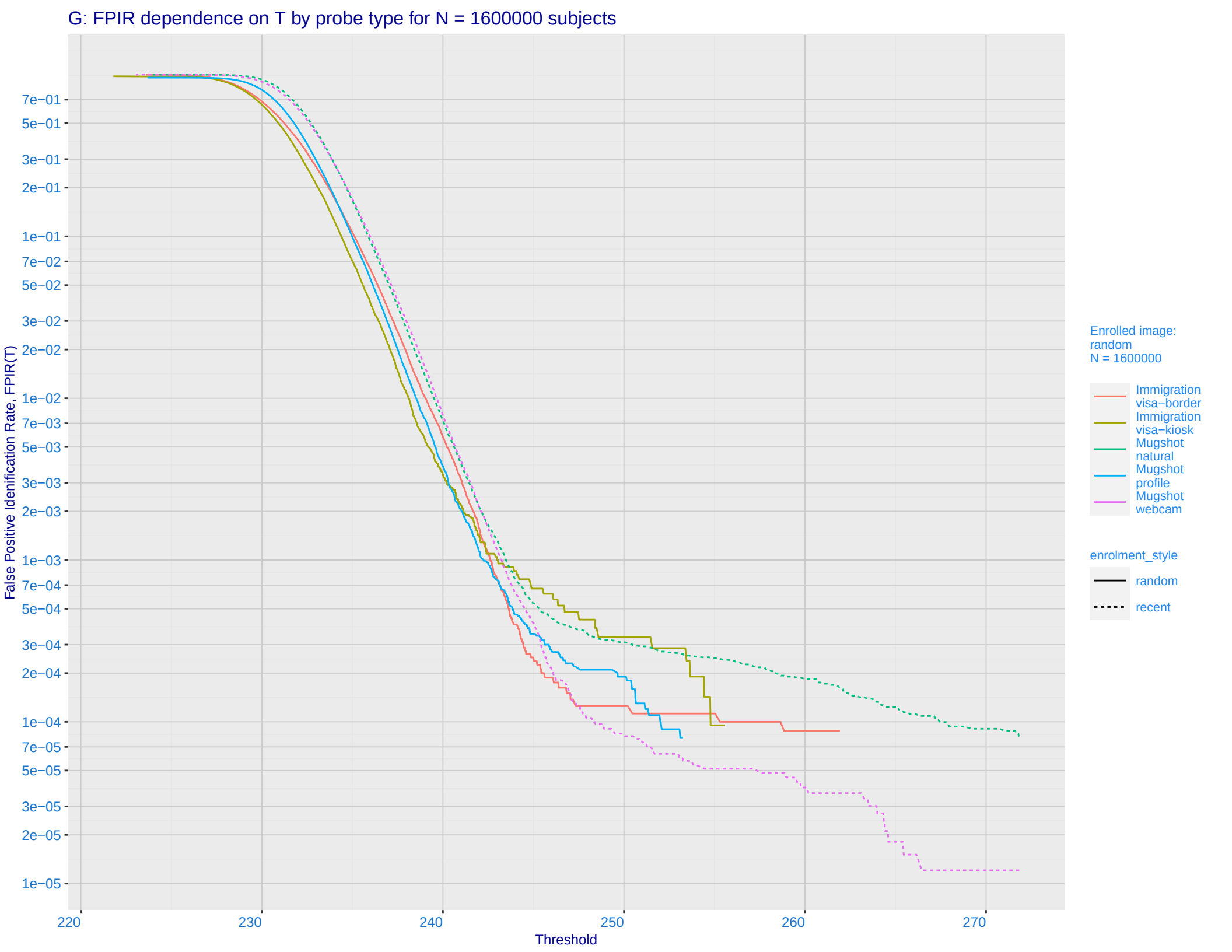
C: Evolution of accuracy for CLOUDWALK_HR algorithms on three datasets 2018 − present

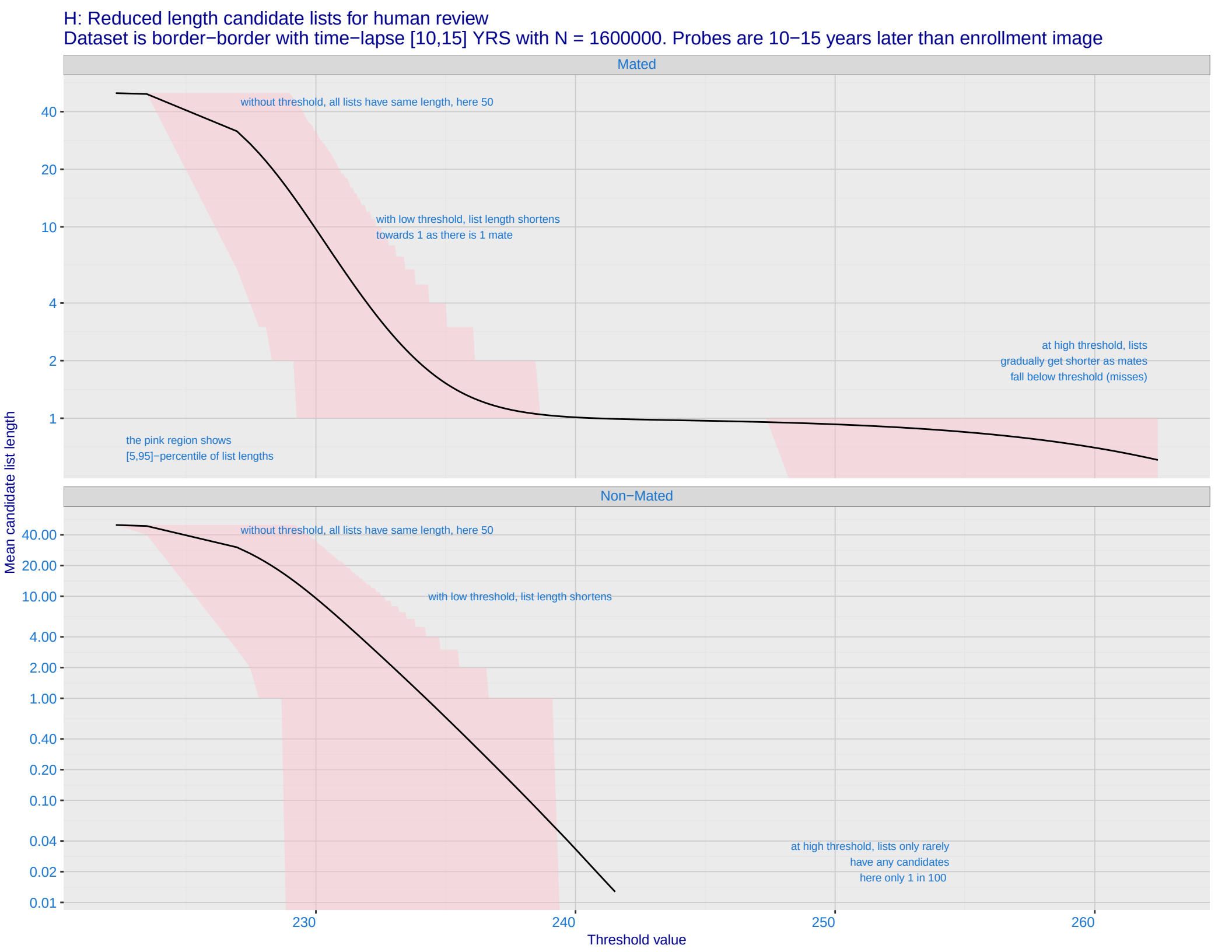


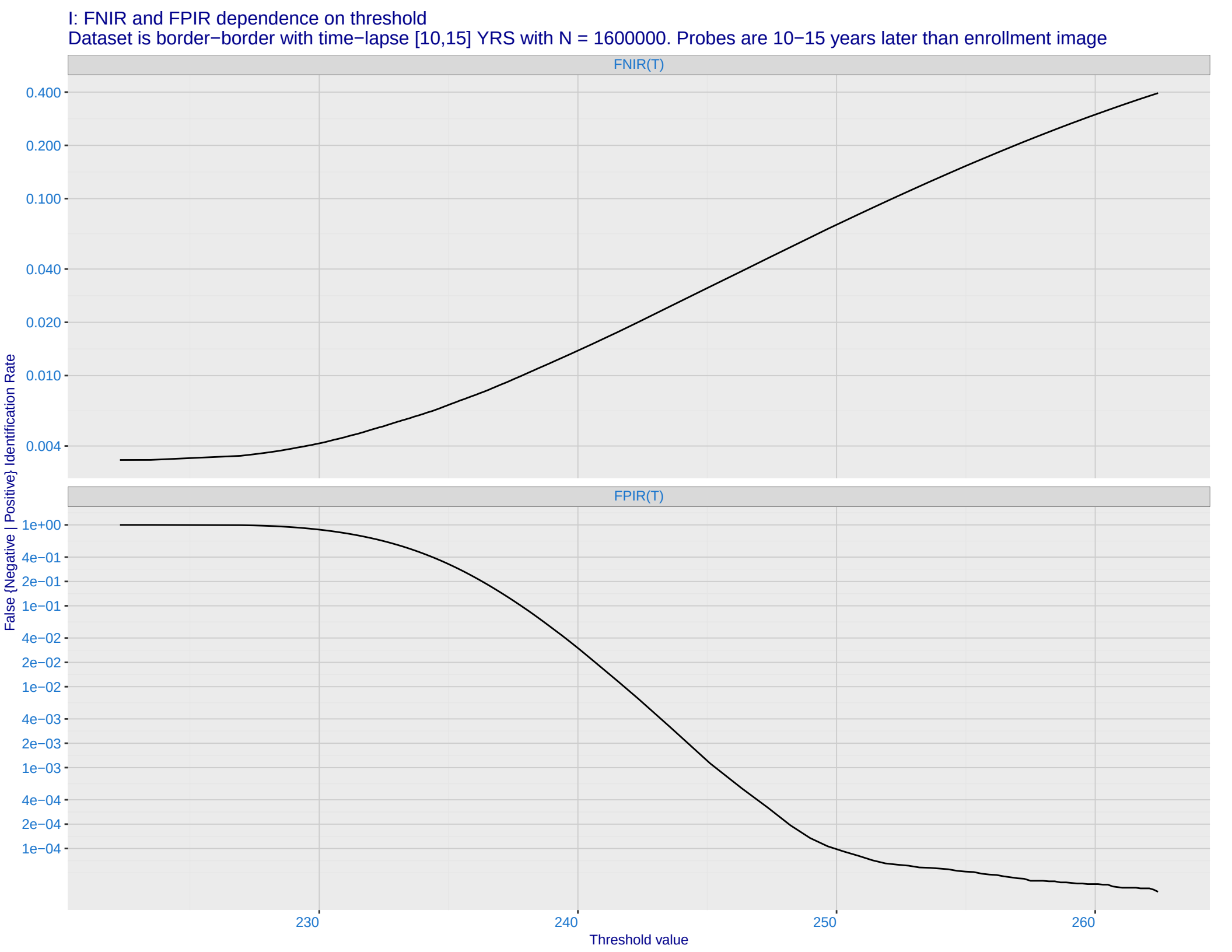

D: 1:N error tradeoff by dataset and enrollment type. N = 1600000 individuals
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
cloudwalk_hr_000
sensetime_004
False negative identification rate, FNIR(T)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
1e+00
False positive identification rate, FPIR(T)
enrolment_style
random−ONE−MATE
recent−ONE−MATE

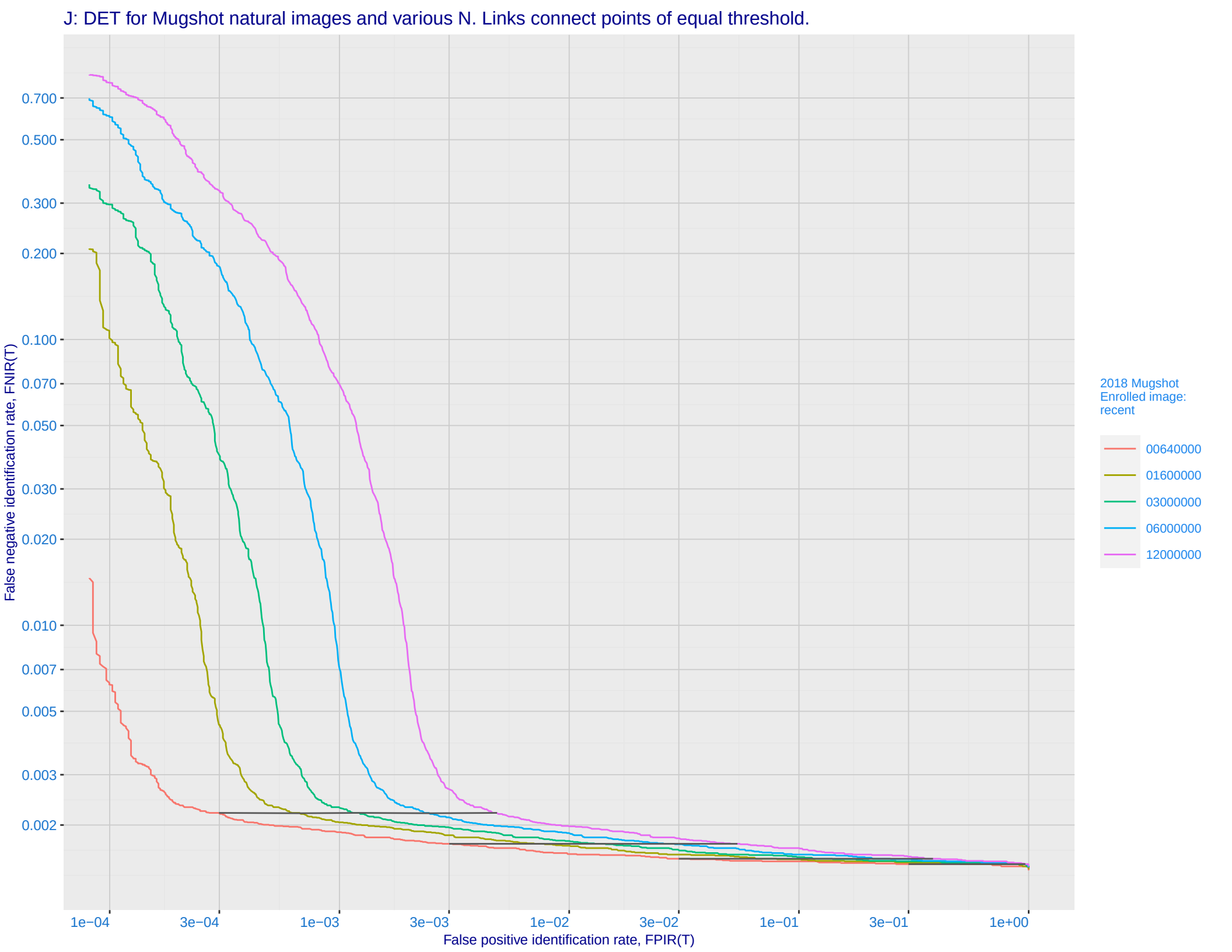

E: Dependence of error rates on T by number enrolled identities, N, for Mugshot natural images
N
00640000
01600000
03000000
06000000
12000000
recent
FNIR
FPIR
Identification Error rate, FPIR(T) or FNIR(T)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05
220
240
260
280
Threshold

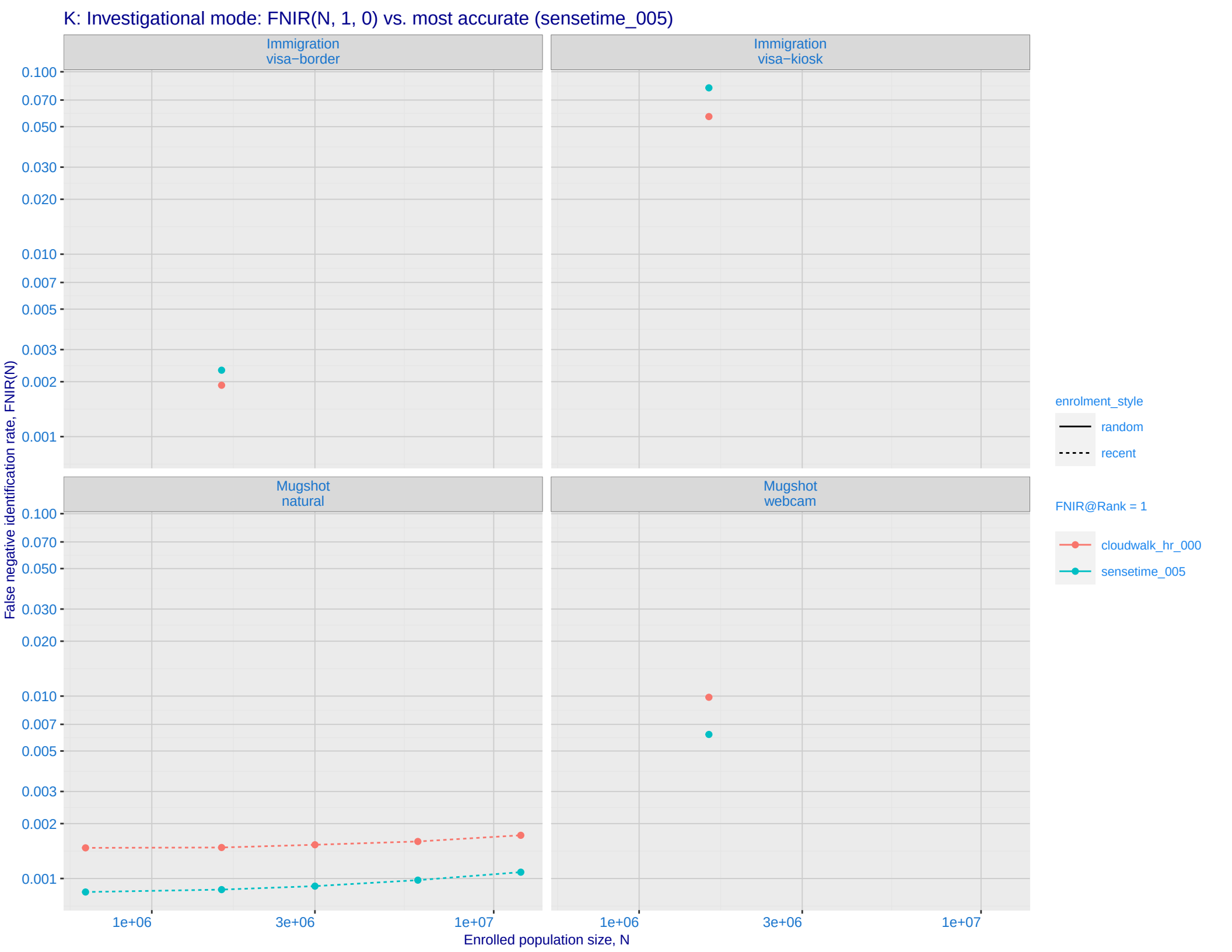

F: FPIR vs. Selectivity for mugshot images, N = 1600000 subjects enrolled with one recent mate
Selectivity, SEL(T)
7e+01
5e+01
3e+01
2e+01
1e+01
7e+00
5e+00
3e+00
2e+00
1e+00
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05
5e−05
3e−05
2e−05
1e−05
1e−05
3e−05
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
False Positive Idenification Rate, FPIR(T)
Enrolled images:
recent
N = 1600000
Mugshot
natural
Mugshot
webcam

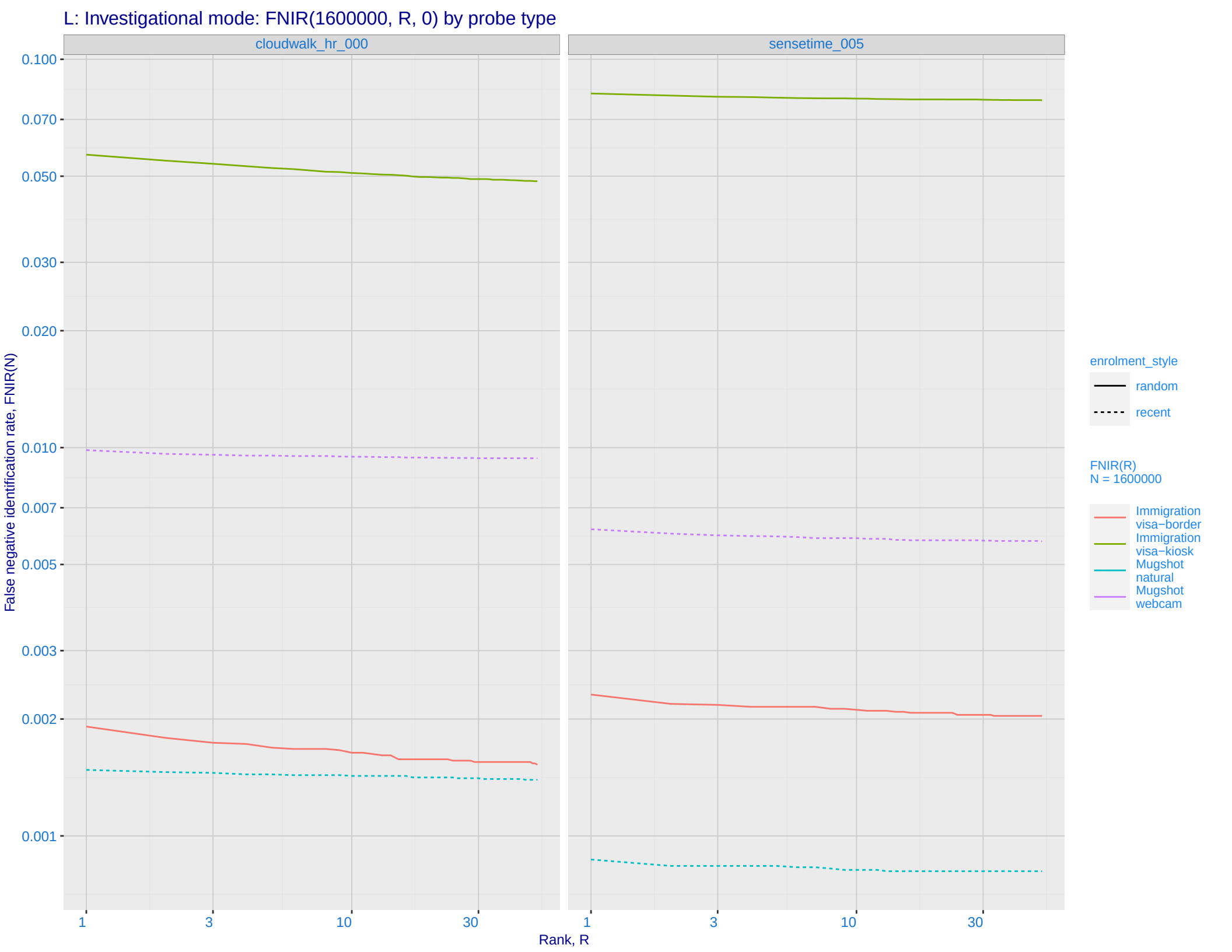

G: FPIR dependence on T by probe type for N = 1600000 subjects
False Positive Idenification Rate, FPIR(T)
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05
5e−05
3e−05
2e−05
1e−05
220
230
240
250
260
270
Threshold
Enrolled image:
random
N = 1600000
Immigration
visa−border
Immigration
visa−kiosk
Mugshot
natural
Mugshot
profile
Mugshot
webcam
enrolment_style
random
recent


H: Reduced length candidate lists for human review
Dataset is border−border with time−lapse [10,15] YRS with N = 1600000. Probes are 10−15 years later than enrollment image
Mated
without threshold, all lists have same length, here 50
with low threshold, list length shortens
towards 1 as there is 1 mate
at high threshold, lists
gradually get shorter as mates
fall below threshold (misses)
the pink region shows
[5,95]−percentile of list lengths
Non−Mated
without threshold, all lists have same length, here 50
with low threshold, list length shortens
at high threshold, lists only rarely
have any candidates
here only 1 in 100
Mean candidate list length
Threshold value

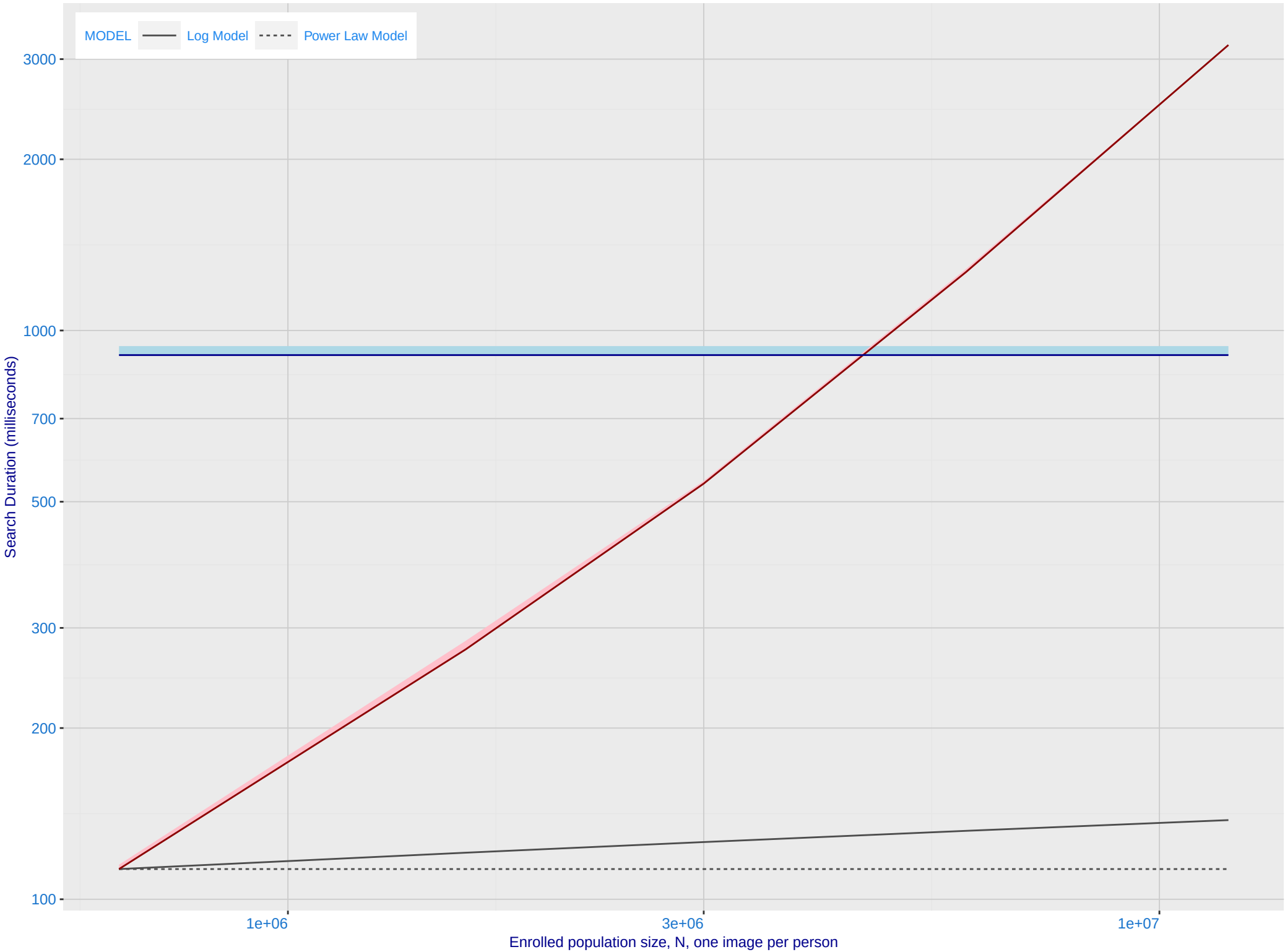

I: FNIR and FPIR dependence on threshold
Dataset is border−border with time−lapse [10,15] YRS with N = 1600000. Probes are 10−15 years later than enrollment image
FNIR(T)
0.400
0.200
0.100
0.040
0.020
0.010
0.004
FPIR(T)
1e+00
4e−01
2e−01
1e−01
4e−02
2e−02
1e−02
4e−03
2e−03
1e−03
4e−04
2e−04
1e−04
False {Negative | Positive} Identification Rate
230
240
250
260
Threshold value

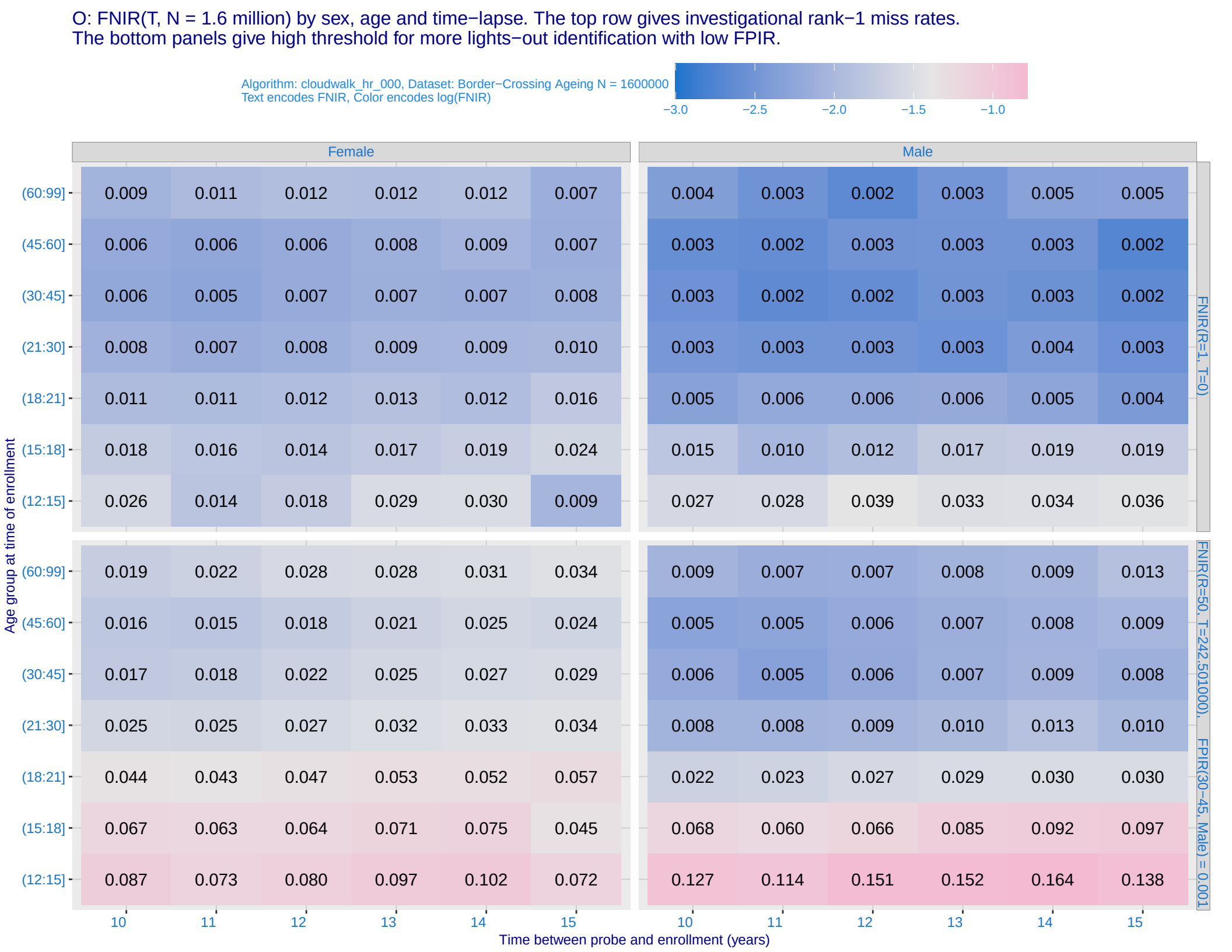

J: DET for Mugshot natural images and various N. Links connect points of equal threshold.
False negative identification rate, FNIR(T)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
1e+00
False positive identification rate, FPIR(T)
2018 Mugshot
Enrolled image:
recent
00640000
01600000
03000000
06000000
12000000


K: Investigational mode: FNIR(N, 1, 0) vs. most accurate (sensetime_005)
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
Mugshot webcam
False negative identification rate, FNIR(N)
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e+06
3e+06
1e+07
Enrolled population size, N
enrolment_style
random
recent
FNIR@Rank = 1
cloudwalk_hr_000
sensetime_005

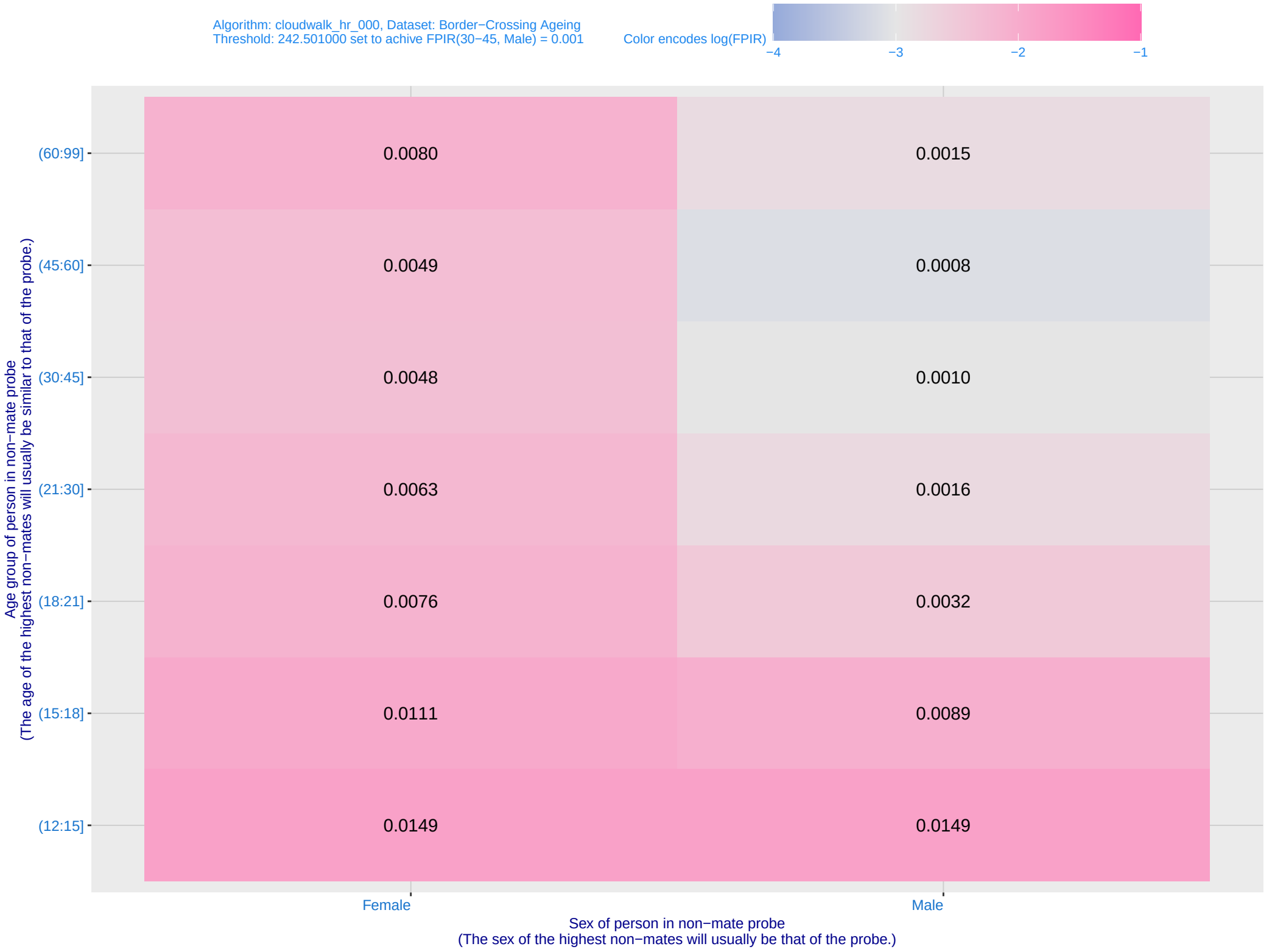

L: Investigational mode: FNIR(1600000, R, 0) by probe type
cloudwalk_hr_000
sensetime_005
False negative identification rate, FNIR(N)
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1
3
10
30
Rank, R
enrolment_style
random
recent
FNIR(R)
N = 1600000
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
Mugshot webcam

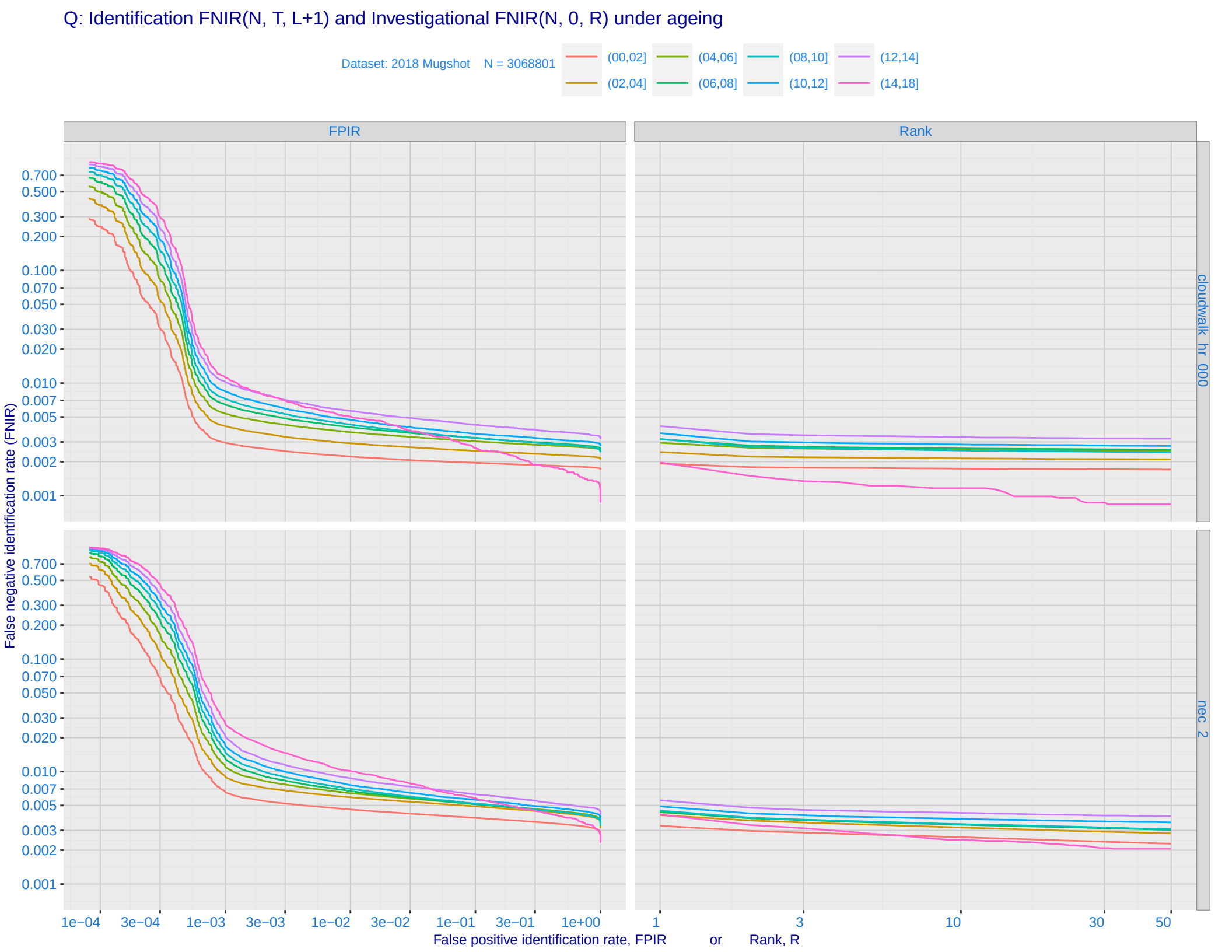
M: Template duration; search duration vs. N. The blue and pink ribbon covers 95 percent of observed measurements.
The template generation time is independent of N. The log and power−law models are fit to the first two (N,T) observations

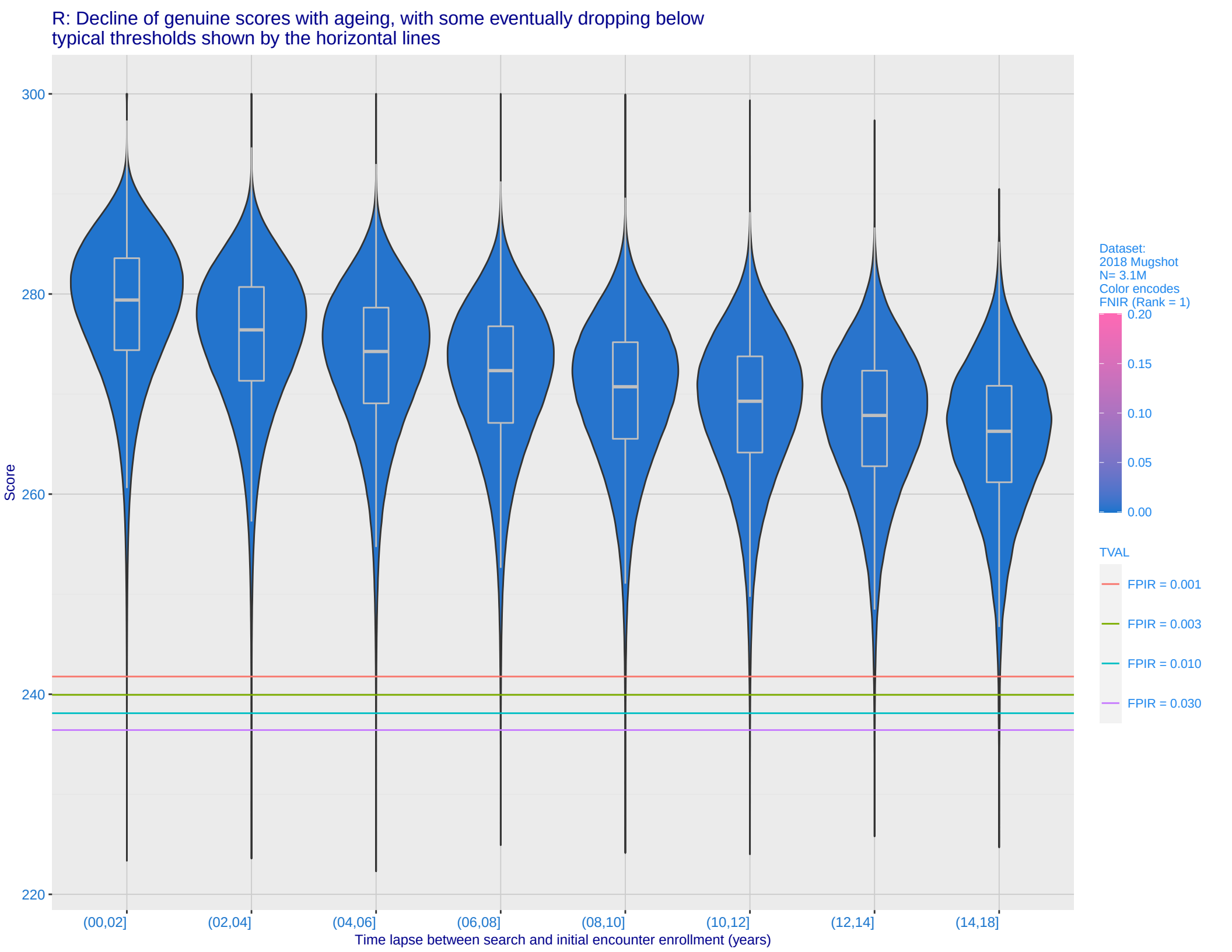



O: FNIR(T, N = 1.6 million) by sex, age and time−lapse. The top row gives investigational rank−1 miss rates.
The bottom panels give high threshold for more lights−out identification with low FPIR.
Algorithm: cloudwalk_hr_000, Dataset: Border−Crossing Ageing N = 1600000
Text encodes FNIR, Color encodes log(FNIR)
−3.0
−2.5
−2.0
−1.5
−1.0
Female
Male
FNIR(R=1, T=0)
FNIR(R=50, T=242.501000), FPIR(30−45, Male) = 0.001
Age group at time of enrollment
(60:99]
(45:60]
(30:45]
(21:30]
(18:21]
(15:18]
(12:15]
0.009 0.011 0.012 0.012 0.012 0.007
0.006 0.006 0.006 0.008 0.009 0.007
0.006 0.005 0.007 0.007 0.007 0.008
0.008 0.007 0.008 0.009 0.009 0.010
0.011 0.011 0.012 0.013 0.012 0.016
0.018 0.016 0.014 0.017 0.019 0.024
0.026 0.014 0.018 0.029 0.030 0.009
0.004 0.003 0.002 0.003 0.005 0.005
0.003 0.002 0.003 0.003 0.003 0.002
0.003 0.002 0.002 0.003 0.003 0.002
0.003 0.003 0.003 0.003 0.004 0.003
0.005 0.006 0.006 0.006 0.005 0.004
0.015 0.010 0.012 0.017 0.019 0.019
0.027 0.028 0.039 0.033 0.034 0.036
0.019 0.022 0.028 0.028 0.031 0.034
0.016 0.015 0.018 0.021 0.025 0.024
0.017 0.018 0.022 0.025 0.027 0.029
0.025 0.025 0.027 0.032 0.033 0.034
0.044 0.043 0.047 0.053 0.052 0.057
0.067 0.063 0.064 0.071 0.075 0.045
0.087 0.073 0.080 0.097 0.102 0.072
0.009 0.007 0.007 0.008 0.009 0.013
0.005 0.005 0.006 0.007 0.008 0.009
0.006 0.005 0.006 0.007 0.009 0.008
0.008 0.008 0.009 0.010 0.013 0.010
0.022 0.023 0.027 0.029 0.030 0.030
0.068 0.060 0.066 0.085 0.092 0.097
0.127 0.114 0.151 0.152 0.164 0.138
10 11 12 13 14 15
10 11 12 13 14 15
Time between probe and enrollment (years)

P: FPIR(N = 1.6 million) by sex and age. It is typical for false positive identification rates to be higher in women except in their teens.




Q: Identification FNIR(N, T, L+1) and Investigational FNIR(N, 0, R) under ageing
Dataset: 2018 Mugshot N = 3068801
(00,02]
(02,04]
(04,06]
(06,08]
(08,10]
(10,12]
(12,14]
(14,18]
FPIR
Rank
cloudwalk hr 000
nec 2
False negative identification rate (FNIR)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
1e+00
1
3
10
30
50
False positive identification rate, FPIR or Rank, R


R: Decline of genuine scores with ageing, with some eventually dropping below typical thresholds shown by the horizontal lines
Score
300
280
260
240
220
(00,02]
(02,04]
(04,06]
(06,08]
(08,10]
(10,12]
(12,14]
(14,18]
Time lapse between search and initial encounter enrollment (years)
Dataset:
2018 Mugshot
N= 3.1M
Color encodes
FNIR (Rank = 1)
0.20
0.15
0.10
0.05
0.00
TVAL
FPIR = 0.001
FPIR = 0.003
FPIR = 0.010
FPIR = 0.030